

# PATENT ABSTRACTS OF JAPAN

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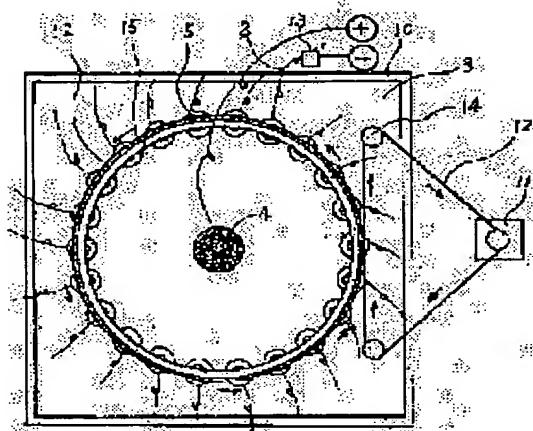
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**(54) METHOD FOR MANUFACTURING PARTS FOR OPTICAL FIBER CONNECTOR****(57)Abstract:**

**PROBLEM TO BE SOLVED:** To improve productivity and to greatly reduce the entire production cost by easily clearing strict tolerance in bore center deviation and easily eliminating variance of the diameter almost completely.

**SOLUTION:** In the ferrule manufacturing method for using metallic or plastic lines for the mother die and removing the lines after electrocasting, a jig for holding the lines is rotated during the electrocasting and, using one ampere-hour meter 13 for one holding jig 5, the diameter is controlled through the amperometry.

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[Claim(s)]

[Claim 1] Two or more [ 1 of the lines 9, such as a metal and plastics, or ] are used for a matrix. After electroforming, the line 9 of the maintenance fixture 5 is made to rotate in a electrocasting tub in the manufacture approach of a ferrule of removing a line 9. And the manufacture approach of the ferrule characterized by carrying out thickness management by the approach of cutting a direct current when one ampere-hour meter is attached in one set of the maintenance fixture 5 and an addition current value turns into a predetermined numeric value.

[Claim 2] The manufacture approach of the ferrule according to claim 1 characterized by passing a direct current with one rectifier to one set of the maintenance fixture 5.

[Claim 3] The manufacture approach of the ferrule according to claim 1 characterized by making equal spacing of each maintenance fixture 5 and the plus electrode 4.

[Detailed Description of the Invention]

[0001]

[Industrial Application] When this invention is explained in more detail about the manufacture approach of optical connector components, an optical connector Although the location of the cores which exist at the core of an optical fiber when a cross section supports through the optical fiber of the size of 0.125mmphi in tubing of a cylindrical shape in a perfect circle form is doubled correctly, connection is aimed at and it is realized with some components It is related with the manufacture approach of the components generally called ferrule of being in the core and holding optical FAIBA.

[0002]

[Description of the Prior Art] Conventionally, the ferrule which is one of the components for optical connectors is a configuration as shown in drawing 1 (a) and (b), and that for which the quality of the material used zirconia ceramics occupies the mainstream. Drawing 1 (a) is the one mind type ferrule 1, the perfect circle form hole 2

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of 0.127mmphi extent is punched at the core by the shape of a cylindrical shape with a 2mm phi extent [ of sizes ], and a die length of about 8mm, and drawing 1 (b) is a double face type thing.

[0003] The metal ferrule manufactured with metals, such as nickel, by the approach of on the other hand machining after this invention person electroforms the line of a metal or plastics to a matrix in Japanese Patent Application No. No. 375372 [ ten to ] using two or more [ 1 or ] and removes the line concerned is proposed.

[0004] In the patent concerned, if electrocasting is carried out and it explains in detail with the equipment of an outline as shown, for example in drawing 2 , in drawing 2 , it consists of electrocasting liquid 3, the plus electrode 4, the maintenance fixture 5, the compressed-air-agitation nozzle 6, a spring 7, a minus electrode 8, and a line 9.

[0005] It considers as the configuration which arranged the plus electrode 4 which put in the nickel ball at the titanium basket of a cylindrical shape into the electrocasting liquid 3 which uses the warmed nickel amiosulfonate as a principal component on four corners centering on the maintenance fixture 5. Although the method of passing and electroforming a direct current was proposed having set centering on the maintenance fixture 5 with the minus electrode 8 which fixed the lines 9, such as a stainless steel line, to the condition that the spring 7 pulled, and carrying out little blowdown \*\*\*\*\* of the air from the air churning nozzle 6, there were the following troubles.

[0006] The cavity by partial plugging of the variation in energization nature, such as a contact of the plus electrode 4 arranged on four corners, and the nickel ball of the plus electrode 4 etc. became a cause, thickness deviation occurred well into the electrocasting part, this became a cause, and the main deflection of the hole of a ferrule was generated.

[0007] Moreover, it was often in the electrocast products made with internal stress with generating of the thickness deviation of said electrocasting part to generate a knee, this became a cause and the main deflection of the hole of a ferrule was generated at the time of next machining.

[0008] Moreover, although a current is passed and produced to about 10-20 sets of the maintenance fixtures 5 by one set of a rectifier, usually The variation in a size may appear in the electrocast products to which it was not avoided that a difference appears in the energization nature for every maintenance fixture 5, but this was made as for it as a cause greatly. Moreover, in order to have to carry out the electrocast products of the thinnest maintenance fixture to a predetermined size, there was futility of electrocasting time amount and a electrocasting metal, and there was a problem of 1 \*\* having to

increase the process which arranges a size with machining of a back process.

[0009]

[Problem(s) to be Solved by the Invention] This invention uses two or more [ 1 of lines, such as a metal wire, or ] for a matrix in view of the above. By clearing easily the precision of the very severe main deflection of \*\*several microns in the manufacture approach of a ferrule of removing the line concerned, after electrocasting, and abolishing most variations of a size, and obtaining a predetermined dimension In machining which is a back process, by making it easy to obtain a size predetermined only by the finish by center loess, time and effort is lessened remarkable, and productivity is raised and it is making to lower the manufacture costs of the ferrule by electrocasting remarkably into the technical problem.

[0010]

[Means for Solving the Problem] In order to solve said technical problem, this invention was electroformed making a line 9 rotate, as shown in drawing 3 and drawing 4 , and the approach of attaching an ampere-hour meter in all for every one maintenance fixture, and making the amount of addition currents regularity was used for it.

[0011] Namely, although drawing 3 is an example of the electrocasting equipment concerning this invention and it is the top view showing the configuration of an outline It consists of electrocasting liquid 3, the plus electrode 4, the maintenance fixture 5, the minus electrode 8, the electrocasting tub 10, the drive motor 11 for maintenance fixture rotation, a belt 12, an ampere-hour meter 13, a block 14, and the structure 15 for fixture immobilization. In the condition of having filtered [ put in electrocasting liquid 3, warmed and ] and agitated in the electrocasting tub 10 The minus electrode 8 and an ampere-hour meter 13 are connected with the plus electrodes 4 and each maintenance fixtures 5 of all. Minded rotation of a sink and the drive motor 11 for maintenance fixture rotation for a direct current in the condition of having often managed, minded the block 14 by the belt 12, transmitted to the maintenance fixture 5 of the structure 15 for fixture immobilization, the maintenance fixture 5 was made to rotate, and it electroformed, and considered as the configuration which cuts fixed addition current value \*\*\*\*\* currents.

[0012] Although electrocasting liquid 3 is the quality of the material of the electrocasting metal made into the purpose and it differs, respectively if it explains in more detail For example, nickel or its alloy, iron or its alloy, copper or its alloy, cobalt, or its alloy, Electrocasting metals, such as a tungsten alloy and a particle distribution metal, are employable. Nickel amiosulfonate, a nickel chloride, a nickel sulfate, the first

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iron of sulfamic acid, The HOUFUTSU-ized first iron, a pyrophosphoric-acid drum, a copper sulfate, HOUFUTSU-ized copper, cay copper fluoride, The water solution which uses water solutions, such as titanium copper fluoride, alkanol sulfonic acid copper, cobalt sulfate, and sodium tungstate, as a principal component, Or the liquid which made these liquid distribute impalpable powder, such as silicon carbide, tungsten carbide, boron carbide, a zirconium dioxide, CHITSU-ized silicon, an alumina, and a diamond, is used. The bath which uses nickel amiosulfonate as a principal component especially among these is suitable in the ease of doing of electrocasting in respect of the versatility of physical properties, such as a degree of hardness, chemical stability, the ease of welding, etc. And as for electrocasting liquid, it is desirable to sometimes use into an anode plate the iron corrugated plate which carried out high-speed filtration, and warmed with the filter of about 0.1-5 micrometers of filtration accuracies, and carried out the temperature control to the appropriate temperature range of about \*\*3 degrees C, and carried out activated carbon treatment, and removed and carried out nickel plating of the organic impurities, to use carbon as cathode, to energize by the about two 0.2 A/dm low current consistency, and to remove metal impurities, such as copper.

[0013] The plus electrode 4 changes with electrocasting metals made into the purpose, and is selected from nickel, iron, copper, cobalt, etc., and tabular and a spherical thing are suitably used for it. What is necessary is just to use it, putting into the basket made from titanium and covering with the cloth bag made from polyester, when using a spherical thing. And the plus electrode 4 is arranged on the core of the circular structure 15 for fixture immobilization. Although it is desirable, from a electrocasting rate becoming [ making it all the maintenance fixtures 5 and a location at equal intervals ] fixed, and electrocasting being mostly completed between coincidence the location of the plus electrode 4 You may make it the configuration which was not limited to this location, for example, arranged the plus electrode 4 on two or more places in accordance with the outer wall of the electrocasting tub 10, and the structure 15 for fixture immobilization may not necessarily be circular, either, for example, may be an ellipse form.

[0014] And although churning can adopt churning of air, a propeller, a supersonic wave, super-vibration, etc., it is also possible to make the rate of rotation of a maintenance fixture quick and to omit churning by addition of a pit prevention agent.

[0015] moreover, drawing 3 -- setting -- the maintenance fixture 5 -- one set -- an ampere-hour meter 13 -- the configuration which uses one set -- \*\* -- although it carries out, and a rectifier is desirable in order that using each one small thing of the

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maintenance fixture 5 for one set may tend to carry out current management, it is not necessarily limited to this but you may energize to many maintenance fixtures 5 with one large-sized rectifier.

[0016] Although drawing 4 is the side elevation of an outline showing the detail of maintenance fixture 5 near [ one example concerning this invention ] It consists of the structure 15 for fixture immobilization, the maintenance rod 16, the free rotation section 17, belt \*\*\*\* 18, a belt 12, the electric insulation section 19, the minus electrode spring 20, the connection section 21, the maintenance fixture 5, a spring 7, a line 9, and a clip 22. The maintenance rod 16 is welded to the circular structure 15 for fixture immobilization, and it is made to idle in the free rotation section 17. Transmit rotation of a belt 12 to belt \*\*\*\* 18, rotate, and the maintenance fixture 5 is made to rotate through the electric insulation section 19 and the connection section 21. The maintenance fixture 5 What is necessary is to hold, after the clip 22 and the spring 7 have pulled the line 9, to make it a location as shows the electrocasting oil level 23 to drawing 4 , to carry out a pressure welding to the minus electrode spring 20, to energize a minus current only to the electric insulation section 19 down side, and just to carry out electrocasting.

[0017] In addition, although 10 - 1000rpm extent is suitable for the rate of rotation of the maintenance fixture 5 in this invention, churning is ommissible by not being limited to especially this figure, for example, adopting high-speed rotation of 1000 or more rpm.

[0018] Selection use of the line 9 is suitably carried out from ceramic lines, such as plastics lines, such as metal wires, such as iron or its alloy, aluminum or its alloy, copper or its alloy, and a tungsten alloy, a thing which carried out thin pewter plating on this metal wire and nylon, and polyester, and glass, etc. Among these, as for the case of plastics and a ceramic line, electroless deposition, such as nickel and silver, is needed for a front face for conductive grant. A size, roundness, and a precision high to linearity are required, and, in the case of extrusion by the dice, a metal wire, and a plastics line, a line 9 should just be adjusted by the approach by the wire drawing etc.

[0019] Although electrocasting carries out a direct current with about two 4 - 10 A/dm current density for about 10 to 20 hours, and is cylindrical, although electrocasting is carried out with the above equipments, and it is made to grow up to be the size of 1.0-2.5mmphi extent It is desirable to start by low current, to raise the current gradually, to consider as the configuration in which the current from a rectifier goes out automatically when the amount of addition currents which turns into the predetermined amount of deposits (size) every maintenance fixture 5 is reached, and to carry out

computer management in the beginning in that case.

[0020] Although it is determined whether the class of line 9 to choose draws out the line 9 which exists at the core of electrocast products, it extrudes, or it dissolves with a chemical, what is generally hard to dissolve in a chemical, and draws out what has high tensile strength, or uses extrusion, and it is easy to dissolve in a chemical uses the dissolution.

[0020] What is necessary is just to carry out finish by center loess processing etc. by machining, after drawing out a line 9 in the case of drawing. After dissolving a line 9 after electroforming with one rod in the dissolution and cutting into the die length of an outline, carrying out finish by center loess processing, or finish-machining, after checking that the hole has penetrated, and making it a finished product, the approach of dissolving a line 9 may be adopted.

[0021]

[Function] Making a line 9 rotate in the manufacture approach of a ferrule of using two or more [ 1 or ] for a matrix for the lines 9, such as a metal wire, and removing the line concerned after electrocasting according to the approach of this invention One ampere-hour meter is used for one set of the maintenance fixture 5, and since the approach of cutting a current with a predetermined addition current value for size management was adopted, most of the main deflection of the hole of electrocast products and the variation of a size can be lost.

[0022]

[Example] After being immersed in the water solution of the knickerbockers [ by Nihon Kagaku Sangyo Co., Ltd. of marketing after setting to the condition of having pulled to the maintenance fixture 5 for electrocasting strongly for the elasticity of a spring as a cross section prepared SUSof 0.127mm/ of a perfect circle form / phi 304 line if the example of following this invention is explained, and shown in drawing 3 and drawing 4 and rinsing ] non tuck A, and B mixed liquor for 10 minutes at a room temperature and carrying out mold release processing, it rinsed well. The nickel plate was made into the anode plate and the tub which carried out high-speed filtration by the 1-micrometer filtration accuracy, and warmed the electrocasting bath at 50\*\*2 degrees C was prepared for the electrocasting bath which uses nickel amiosulfonate as a principal component on the other hand. And it carries out until combine the maintenance fixture 5 with electrocasting equipment in the connection section 21, and it sets rotating velocity to 300rpm, and makes a line as cathode, it makes nickel into an anode plate and it becomes a predetermined addition current value about electrocasting with about two 4 - 6 A/dm

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current density. Although 22 nickel electrocast products of the shape of a rod with a die length of 300mm were manufactured by the size of 2.2mmphi, the variation in these 22 sizes fitted in the range of \*\*0.1mm, and did not have a knee, either. Next, the slot was put into electrocast products at intervals of 40mm, it broke from a part for this slot, the main line was drawn out, and then it was processed to the size of 2.000mm, and die length of 8.00mm with NC automatic processing machine, the center loess processing machine, etc., and considered as the finished product. Thus, what was manufactured was a product which has the main deflection of a hole in specification and is satisfactory. [0023]

[Effect of the Invention] This invention does the following effectiveness so by the approach shown above. Since the electrocasting approach which uses 1 or two or more lines 9, such as a metal wire, for a matrix, carries out current management in manufacture of the ferrule which removes the line 9 concerned after electrocasting, rotating, and carries out thickness management with an addition current value for every set of the maintenance fixture 5 was adopted At the same time a main deflection precision of the very severe hole of \*\*several microns is easily clearable, since thickness deviation and a knee are hardly generated in the made electrocast products Since the variation in a size can almost be abolished easily, time and effort of machining of a back process can be lessened, and productivity can be improved remarkably.

[Brief Description of the Drawings]

[Drawing 1] It is the expanded sectional view and side elevation of a ferrule concerning a conventional method.

[Drawing 2] It is the block diagram of the outline of the electrocasting equipment concerning a conventional method.

[Drawing 3] It is the top view of an outline showing one example of the electrocasting equipment concerning this invention.

[Drawing 4] It is the side elevation showing the configuration of the outline near the maintenance fixture of the rotation electrocasting equipment concerning this invention.

[Description of Notations]

1 Ferrule 2 Perfect Circle Form Hole

3 Electrocasting Liquid 4 Plus Electrode

5 Maintenance Fixture 6 Compressed-Air-Agitation Nozzle

7 Spring 8 Minus Electrode

9 Line 10 Electrocasting Tub

11 Drive Motor for Maintenance Fixture Rotation 12 Belt  
13 Ampere-hour Meter 14 Block  
15 Structure for Fixture Immobilization 16 Maintenance Rod  
17 Free Rotation Section 18 Belt \*\*\*\*  
19 Electric Insulation Section 20 Minus Electrode Spring  
21 Connection Section 22 Clip  
23 Electrocasting Oil Level

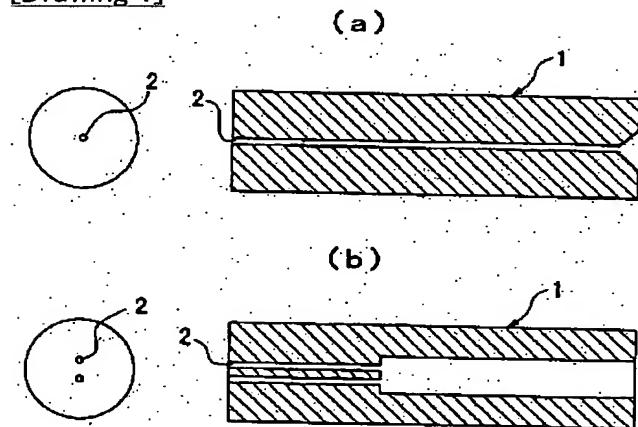
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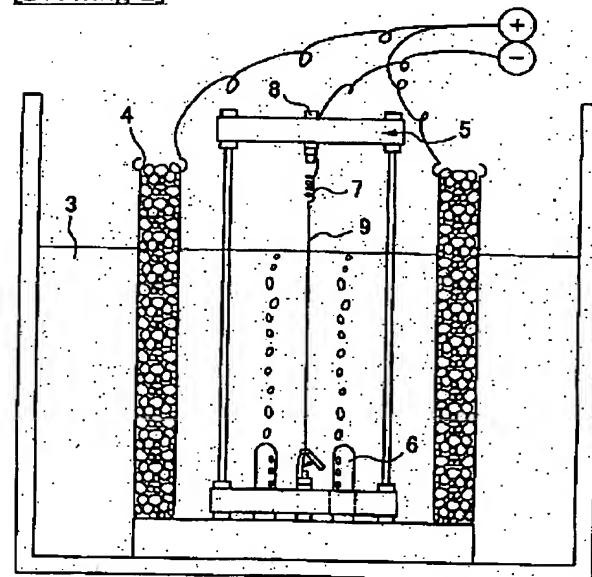
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## DRAWINGS

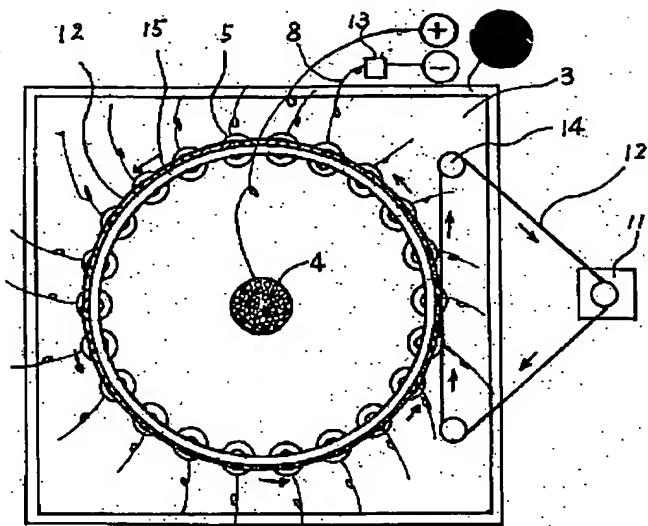
## [Drawing 1]



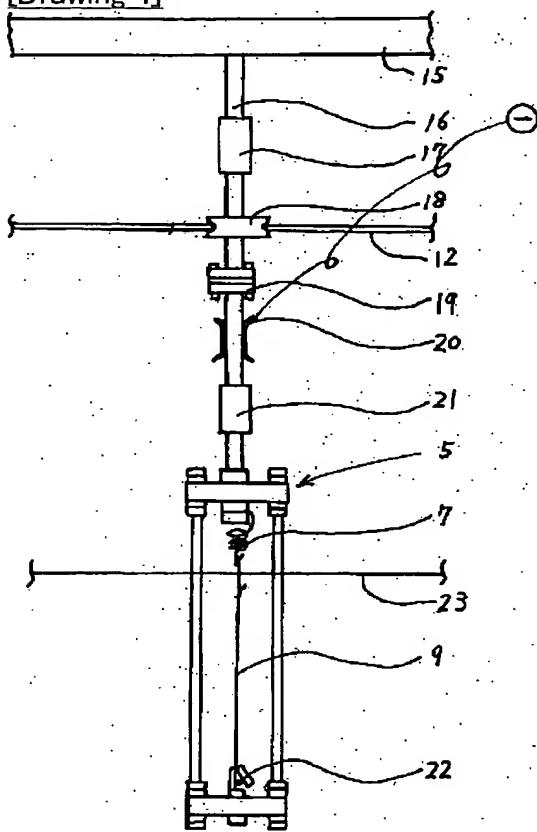
## [Drawing 2]



## [Drawing 3]



[Drawing 4]



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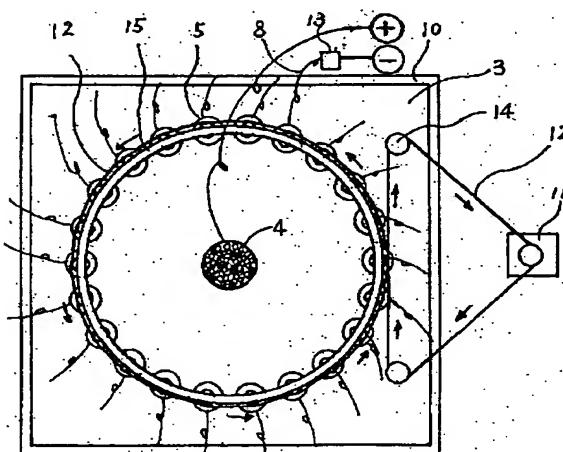
(54)【発明の名称】光ファイバコネクタ用部品の製造方法

(57)【要約】

金属、プラスチックなどの線を母型に使用し、電鋳してから線を除去するフェルールの製造方法に於いて、線を自転しながら電鋳して積算電流値により太さ管理する。

【目的】厳しい孔の中心振れ精度を容易にクリアし、また太さのバラツキを容易に殆ど無くして、生産性を向上し、そして全体の生産コストを著しく下げる。

【構成】電鋳時に線を保持した保持治具を自転させ、一台の保持治具5に一台の積算電流計13を使用して積算電流値により太さ管理する構成とした。



## 【特許請求の範囲】

【請求項1】金属、プラスチックなどの線9の一本、もしくは複数本を母型に使用して、電鋳した後、線9を除去するフェルールの製造方法に於いて、電鋳槽中で保持治具5の線9を自転させ、かつ、保持治具5の一台に積算電流計一台を取り付け積算電流値が所定の数値になった時に直流電流を切る方法により太さ管理することを特徴とするフェルールの製造方法。

【請求項2】保持治具5の一台に整流器一台で直流電流を流すことを特徴とする請求項1記載のフェルールの製造方法。

【請求項3】個々の保持治具5とプラス電極4との間隔を等しくしたことを特徴とする請求項1記載のフェルールの製造方法。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は、光ファイバコネクタ部品の製造方法に関するものであり、更に詳しく説明すると、光ファイバコネクタは、断面が真円形で0.125mmφの太さの光ファイバを円筒形の管に通して支えることにより、光ファイバの中心にあるコア同士の位置を正確に合わせて接続を図るものであり、いくつかの部品で成り立っているが、その中心部にあって光ファイバを保持する、一般にフェルールと言われる部品の製造方法に関するものである。

## 【0002】

【従来の技術】従来、光ファイバコネクタ用部品の一つであるフェルールは、例えば図1(a) (b)に示すような形状であり、材質は、ジルコニアセラミックスを使用したものが主流を占めている。図1(a)は、一心タイプのフェルール1で、太さ2mmφ程度、長さ8mm程度の円柱形状で中心に0.127mmφ程度の真円形孔2が穿孔されたものであり、図1(b)は、二心タイプのものである。

【0003】一方、本発明者が、特願平10-375372号に於いて金属またはプラスチックの線を一本または複数本を母型に使用して電鋳し、当該線を除去した後機械加工する方法によりニッケルなどの金属で製造した金属製フェルールを提案している。

【0004】当該特許においては、例えば図2に示すような概略の装置で電鋳を実施しており、詳しく説明すると、図2においては、電鋳液3、プラス電極4、保持治具5、空気攪拌ノズル6、バネ7、マイナス電極8、線9で構成されている。

【0005】加温したスルファミン酸ニッケルなどを主成分とする電鋳液3の中に円筒形のチタンバスケットにニッケル球を入れたプラス電極4を保持治具5を中心にして四隅に配した構成とし、ステンレス線などの線9をバネ7で引っ張った状態に固定したマイナス電極8のある保持治具5を中心にして、エア攪拌ノズル6か

らエアを少量吹き出して攪拌しながら直流電流を流して電鋳する方法が提案されているが、次のような問題点が有った。

【0006】四隅に配したプラス電極4の接点などの通電性のバラツキ、プラス電極4のニッケル球の部分的な詰まりによる空洞などが原因となって電鋳部分に偏肉がよく発生し、これが原因となってフェルールの孔の中心振れを発生していた。

【0007】また、前記電鋳部分の偏肉の発生に伴い、内部応力によって出来た電鋳品に曲りを発生する事がしばしばあり、これが原因となって後の機械加工時にフェルールの孔の中心振れを発生していた。

【0008】また通常は、一台の整流器で10~20台程の保持治具5に電流を流して生産するが、保持治具5ごとの通電性に差の出ることが避けられず、これを原因として出来た電鋳品に太さのバラツキが大きく出ることがあり、また最も細い保持治具の電鋳品を所定の太さまでしなければならないために電鋳時間と電鋳金属のムダがあり、そして後工程の機械加工に、太さを揃える工程を一工程増やさなければならないなどの問題があった。

## 【0009】

【発明が解決しようとする課題】本発明は以上に鑑み、金属線などの線の一本、もしくは複数本を母型に使用し、電鋳後、当該線を除去するフェルールの製造方法に於いて、±5ミクロンという極めて厳しい中心振れの精度を容易にクリアし、また太さのバラツキを殆ど無くして所定の寸法を得ることにより、後工程である機械加工において、センタレスによる仕上加工だけで所定の太さを得ることを容易にすることにより、手間を著しく少なくして生産性を高め、電鋳によるフェルールの製造費用を著しく下げることを課題としている。

## 【0010】

【課題を解決するための手段】本発明は、前記課題を解決するために、図3、図4に示すように線9を自転せながら電鋳し、保持治具一台ごとの全てに積算電流計を取り付け積算電流量を一定にする方法を採用した。

【0011】即ち図3は本発明に係る電鋳装置の一例であり概略の構成を示す平面図であるが、電鋳液3、プラス電極4、保持治具5、マイナス電極8、電鋳槽10、保持治具自転用駆動モータ11、ベルト12、積算電流計13、滑車14、治具固定用構造体15で構成されており、電鋳槽10中に電鋳液3を入れ、加温し、濾過し、攪拌した状態で、プラス電極4と個々の保持治具5の全てに、マイナス電極8と積算電流計13を連結して、よく管理した状態で直流電流を流し、保持治具自転用駆動モータ11の回転をベルト12で滑車14を介して治具固定用構造体15の保持治具5に伝達して保持治具5を自転させて電鋳し、一定の積算電流値なったら電流を切る構成とした。

【0012】さらに詳しく説明すると、電鋳液3は、目

的とする電鋳金属の材質で、それぞれ異なっているが、例えばニッケル又はその合金、鉄又はその合金、銅又はその合金、コバルト又はその合金、タンクステン合金、微粒子分散金属などの電鋳金属が採用可能であり、スルファミン酸ニッケル、塩化ニッケル、硫酸ニッケル、スルファミン酸第一鉄、ホウフ化第一鉄、ビロリン酸銅、硫酸銅、ホウフ化銅、ケイフ化銅、チタンフ化銅、アルカノールスルフォン酸銅、硫酸コバルト、タンクステン酸ナトリウムなどの水溶液を主成分とする水溶液、又は、これらの液に炭化ケイ素、炭化タンクステン、炭化ホウ素、酸化ジルコニウム、チッ化ケイ素、アルミナ、ダイヤモンドなどの微粉末を分散させた液が使用される。これらのうち特にスルファミン酸ニッケルを主成分とする浴が、電鋳のやり易さ、硬度などの物性の多様性、化学的安定性、溶接の容易性などの面で適している。そして、電鋳液は、濾過精度 $0.1 \sim 5 \mu\text{m}$ 程度のフィルターで高速濾過し、また加温して $\pm 3^\circ\text{C}$ 程度の適性温度範囲に温度コントロールし、また時々、活性炭処理をして有機不純物を除去し、またニッケルメッキした鉄製の波板を陽極、カーボンを陰極にして $0.2\text{A}/\text{dm}^2$ 程度の低電流密度で通電して銅などの金属不純物を除去することが望ましい。

【0013】プラス電極4は、目的とする電鋳金属により異なっており、ニッケル、鉄、銅、コバルトなどから選定され、板状、球状のものを適宜使用する。球状のものを使用する場合は、チタン製バスケットに入れ、ポリエスチル製の布袋で覆って使用すればよい。そして円形の治具固定用構造体15の中心にプラス電極4を配して、保持治具5の全てと等間隔の位置にするのが、電鋳速度が一定になり、ほぼ同時間で電鋳が終了することから望ましいが、プラス電極4の位置は、この位置に限定されず、例えば電鋳槽10の外壁に沿ってプラス電極4を複数箇所に配した構成にしてもよいし、治具固定用構造体15も必ずしも円形でなく例えば楕円形であってもよい。

【0014】そして搅拌は空気、プロペラ、超音波、超振動などの搅拌が採用できるが、保持治具の自転の速度を速くすることと、ピット防止剤の添加により搅拌を省略することも可能である。

【0015】また図3に於いては、保持治具5一台に積算電流計13一台を使用する構成とし、整流器は保持治具5の各一台に小型のものを一台使用するのが電流管理を実施しやすいため望ましいが、必ずしもこれに限定されず大型の整流器一台で多くの保持治具5に通電してもよい。

【0016】図4は、本発明に係る一実施例の保持治具5付近の詳細を示す概略の側面図であるが、治具固定用構造体15、保持棒16、フリー回転部17、ベルト受車18、ベルト12、電気絶縁部19、マイナス電極バネ20、連結部21、保持治具5、バネ7、線9、クリ

ップ22で構成されており、円形の治具固定用構造体15に保持棒16が溶接されており、フリー回転部17で空回りさせ、ベルト12の回転をベルト受車18に伝達して回転し電気絶縁部19、連結部21を介して保持治具5を自転させ、保持治具5は、クリップ22とバネ7で線9を引っ張った状態で保持し、電鋳液面23を図4に示すような位置にして、マイナス電極バネ20と圧接して電気絶縁部19の下側だけにマイナス電流を通電して電鋳を実施すればよい。

【0017】なお本発明における保持治具5の自転の速度は、 $10 \sim 1000\text{ rpm}$ 程度が適當であるが、特にこの数字に限定されず、例えば $1000\text{ rpm}$ 以上の高速回転を採用することにより搅拌を省略できる。

【0018】線9は、鉄またはその合金、アルミニウムまたはその合金、銅またはその合金、タンクステン合金などの金属線、及びこの金属線の上に薄いハンダメッキをしたもの、及びナイロン、ポリエスチルなどのプラスチック線、ガラスなどのセラミック線などから適宜選択使用される。このうちプラスチック、セラミック線の場合は、表面に導電性の付与のためニッケル、銀などの無電解メッキが必要となる。線9は、太さと真円度と直線性に高い精度が要求され、ダイスによる押し出しや金属線、プラスチック線の場合は、伸線による方法などにより調整を実施すればよい。

【0019】上記のような装置で電鋳を実施するが、電鋳は、直流電流を $4 \sim 10\text{ A}/\text{dm}^2$ 程度の電流密度で $10 \sim 20$ 時間程実施し、棒状で $1.0 \sim 2.5\text{ mm}$ φ程度の太さに成長させるが、その際に、始めは低電流で開始し、徐々に電流を高めていき、保持治具5ごとに所定の析出量（太さ）になる積算電流量に達した時点で、自動的に整流器からの電流が切れる構成とし、コンピュータ管理することが望ましい。

【0020】選択する線9の種類により、電鋳品の中心にある線9を引き抜くか、押し出すか、薬品で溶解するかが決定されるが、一般には薬品に溶解しにくく、引っ張り強度の高いものは、引き抜き、または押し出しを利用し、薬品に溶解しやすいものは、溶解を利用する。

【0020】機械加工では、引き抜きの場合においては、線9を引き抜いた後、センタレス加工などで仕上加工を実施すればよい。溶解の場合においては、一本の棒で電鋳した後、概略の長さにカットした後、線9を溶解し、孔が貫通したのを確認した後、センタレス加工で仕上加工をするか、または仕上げ加工して完成品にした後に線9の溶解をする方法を採用してもよい。

【0021】

【作用】本発明の方法によれば、金属線などの線9を一本または複数本を母型に使用し、電鋳後、当該線を除去するフェルールの製造方法に於いて、線9を自転させながら、保持治具5の一台に積算電流計を一台使用し、太さ管理を所定の積算電流値で電流を切る方法を採用した

ので、電鋳品の孔の中心振れと太さのバラツキを殆ど無くすことができる。

【0022】

【実施例】以下本発明の実施例について説明すると、断面が真円形の $0.127\text{ mm}$ のSUS304線を準備し、図3、図4に示す様に電鋳用の保持治具5にバネの弾力で強く引っ張った状態にセットして水洗した後、市販の日本化学産業社製のニッカノンタックA、B混合液の水溶液に室温で10分間浸漬して離型処理した後、よく水洗した。一方スルファミン酸ニッケルを主成分とする電鋳浴に、ニッケル板を陽極とし、電鋳浴を $1\mu\text{m}$ の濾過精度で高速濾過をし、 $50 \pm 2^\circ\text{C}$ に加温した槽を準備した。そして、保持治具5を連結部21で電鋳装置に結合して、自転速度を300 rpmとし、線を陰極、ニッケルを陽極にして $4 \sim 6\text{ A/dm}^2$ 程度の電流密度で電鋳を所定の積算電流値になるまで実施して、 $2.2\text{ m m}$ の太さで、 $300\text{ mm}$ の長さの棒状のニッケル電鋳品を22本製造したが、この22本の太さのバラツキは、 $\pm 0.1\text{ mm}$ の範囲におさまり、また曲りも無かった。次に電鋳品に溝を $40\text{ mm}$ 間隔に入れ、この溝部分から折って中心の線を引き抜き、次にNC自動加工機、センタレス加工機などで太さ $2.000\text{ mm}$ 、長さ $8.00\text{ mm}$ まで加工して完成品とした。このように製造したもののは孔の中心振れが規格内にあり問題のない製品であった。

【0023】

【発明の効果】本発明は、以上に示した方法により以下の効果を奏する。金属線などの1本或いは複数の線9を母型に使用し、電鋳後、当該線9を除去するフェルールの製造において、自転しながら、電流管理し保持治具5の一台ごとに積算電流値により太さ管理する電鋳方法を採用したので、出来た電鋳品に偏肉、曲りを殆ど発生しないため、 $\pm 0.005\text{ mm}$ という極めて厳しい孔の\*

\*中心振れ精度を容易にクリアすることができると同時に、太さのバラツキを容易に殆ど無くすことができることから、後工程の機械加工の手間を少なくでき、生産性を著しく向上することができる。

【図面の簡単な説明】

【図1】従来法に係るフェルールの拡大断面図と側面図である。

【図2】従来法に係る電鋳装置の概略の構成図である。

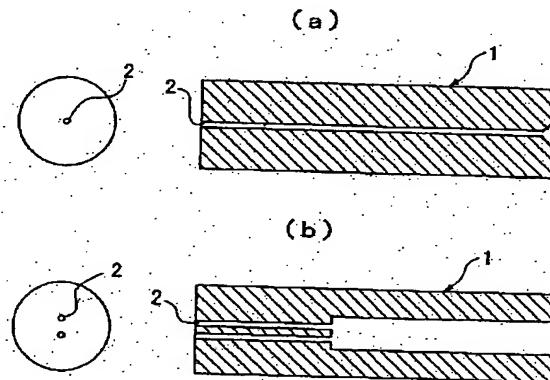
【図3】本発明に係る電鋳装置の一実施例を示す概略の平面図である。

【図4】本発明に係る回転電鋳装置の保持治具付近の概略の構成を示す側面図である。

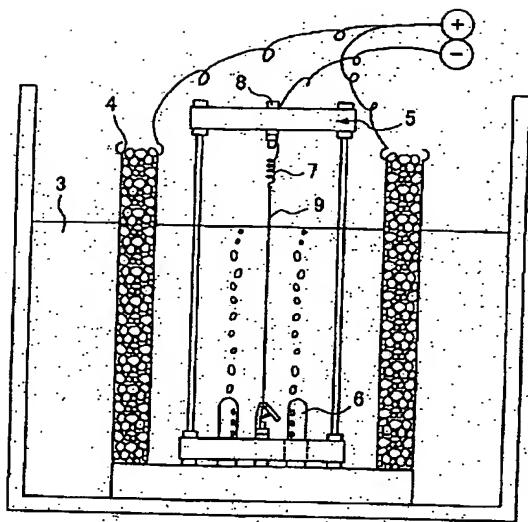
【符号の説明】

1 フェルール	2 真円形
孔	
3 電鋳液	4 ブラス
電極	
5 保持治具	6 空気搅
拌ノズル	
7 バネ	8 マイナ
ス電極	
9 線	10 電鋳槽
11 保持治具自転用駆動モータ	12 ベルト
13 積算電流計	14 滑車
15 治具固定用構造体	16 保持棒
17 フリー回転部	18 ベルト
受車	
19 電気絶縁部	20 マイナ
ス電極バネ	
21 連結部	22 クリップ
ブ	
23 電鋳液面	

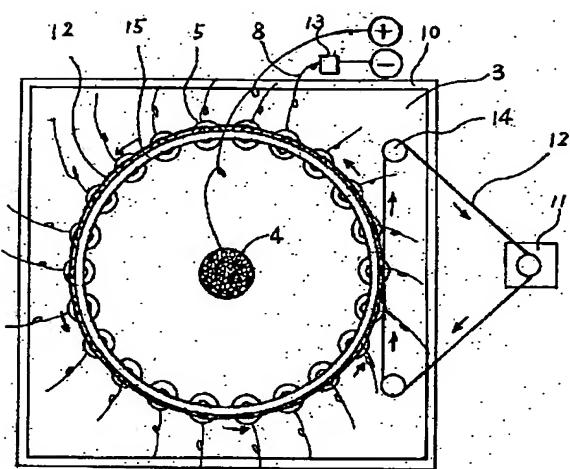
【図1】



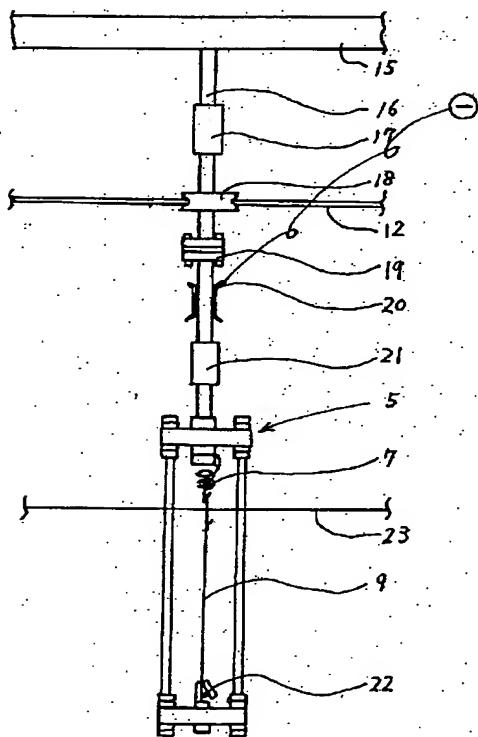
【図2】



【図3】



【図4】



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